

What is claimed is:

1. A spinal fixation system for implant of elongate support means medially of the spine in place of removed portions of spinous processes, said system comprising:
  - a plurality of pedicle screws spaced apart in two columns for fixation in bone on both sides of the spine;
  - a longitudinal support extending along a path between said columns;
  - a first set of arms having proximal ends hinged to said screws in one of said columns, and having distal ends;
  - a second set of arms having proximal ends hinged to said screws in the other of said columns, and having distal ends;
  - a first set of connectors attached to said distal ends of said arms of said first set and to said longitudinal support;
  - a second set of connectors attached to said distal ends of said arms of said second set and to said longitudinal support; and
  - means on said screws and said connectors for locking said proximal ends to said screws and for locking said connectors to said longitudinal support.

2. The system of claim 1 and wherein:

    said connectors are rotatably attached to said distal ends.

3. The system of claim 1 and wherein:

    said connectors are rings and said longitudinal support is received through said rings.

4. The apparatus of claim 3 and wherein:

said means for locking include means for locking said rings to said support.

5. The system of claim 1 and wherein:

said pedicle screws have heads with slots therein, the system further comprising:

pivot pins received in and extending through the proximal ends of said arms and

across said slots and into said screw heads and pivotally mounting said arms to said screw heads; and

said means for locking said proximal ends comprise locking screws in said arms and engaging said pins to lock said arms to said pins, said pins being rotatable in said screw heads.

6. The system of claim 5 and wherein:

said connectors are rings rotatably connected to said distal ends; and

said means for locking said connectors comprise locking screws fixing said rings to said longitudinal support.

7. The system of claim 6 and wherein:

the longitudinal support is a spinal rod.

8. A spinal fixation system for implant of elongate support means medially of the spine in place of removed portions of spinous processes and comprising:

a plurality of pedicle screws spaced apart in two columns for fixation in bone on both sides of the spine;

a longitudinal support extending along a path between said columns; cross supports, each said cross support having two ends, one of said ends being attached to one of said pedicle screws in the one of said columns and the other of said ends being attached to one of said pedicle screws in the other of said columns; and a mounting bracket attached midway between said ends to each of said cross supports and connected to said longitudinal support.

9. The system of claim 8 and wherein:

each of said pedicle screws has a multi-axial cross support end receiver locked to one of said ends of each cross support.

10. The system of claim 8 and wherein:

said mounting brackets have yokes receiving said longitudinal support member.

11. The support system of claim 8 and wherein:

the longitudinal support member is a spinal rod.

12. An articulating spinal fixation system for controlled spinal segmental correction and comprising:

a plurality of bone screws spaced along two paths for anchoring in spinal bone in a first column on one side of the spine and in a second column on the other side of the spine;

a longitudinally extending articulated support assembly extending between said columns, said support assembly including a longitudinally extending support having first and

second telescoping portions and a first cross support fixed on said first portion and a second cross support swivel mounted to said second portion;

    said first cross support having one end connected to one of said bone screws in said first column and having another end connected to one of said bone screws in said second column; and

    said second cross support having one end connected to another bone screw in said first column and said second cross support having another end connected to another bone screw in said second column;

    means for locking said first and second portions to prevent telescoping; and

    means for locking said second cross support to said second portion to prevent pivoting of said second cross support relative to said second portion;

13. The fixation system of claim 12 and further comprising:

    additional longitudinally extending articulated support assemblies connected in series with the first-mentioned longitudinally extending articulated support assembly, and extending longitudinally with and between said columns, for enabling distraction and compression and rotation of spinal segments in a series.

14. A spinal fixation system comprising:

    a plurality of fasteners spaced along two paths for anchoring in spinal bone in a first column on one side of the spine and in a second column on the other side of the spine;

    a longitudinal support for extending along the spine in cavities left by removal of spinous process material;

a plurality of cross supports longitudinally spaced on and connected to said longitudinal support and connected to the said fasteners;

swivel joints at spaced locations on said longitudinal support and connecting selected ones of said cross supports to said longitudinal support;

means for locking said swivel joints to fix said cross supports in various orientations relative to said longitudinal support;

sliding joints at selected locations on said longitudinal support and enabling change of spacing between certain ones of said cross supports; and

means on said longitudinal support for locking said sliding joints to fix spacing between said certain ones of said cross supports.

15. The system of claim 14 and wherein:

said longitudinal support has two interfitting portions at each of the said sliding joints, one of said cross supports being connected to one of said interfitting portions;

another of said cross supports being connected to another of said interfitting portions;

said one and said another of said interfitting portions having colinear axes and being rotatable relative to each other about said colinear axes, whereby said one of said cross supports connected to said one of the interfitting portions is rotatable relative to said another of said cross supports connected to said another of said interfitting portions.

16. A method of instrumentation for patients undergoing spinal treatment and comprising:

at a first motion segment of the spine, placing a first pedicle screw entering the cephalad border of the pars interarticularis at the junction of the caudal aspect of the inferior facet at one side of the spine;

at said first motion segment, placing a second pedicle screw entering the cephalad border of the pars interarticularis at the junction of the caudal aspect of the inferior facet at the other side of the spine;

at a second motion segment of the spine, placing a third pedicle screw entering the cephalad border of the pars interarticularis at the junction of the caudal aspect of the inferior facet at the one side of the spine;

at the said second motion segment, placing a fourth pedicle screw entering the cephalad border of the pars interarticularis at the junction of the caudal aspect of the interior facet at the other side of the spine;

connecting a first cross support to the first and second pedicle screws;

connecting a second cross support to the third and fourth pedicle screws;

connecting a longitudinal support to said first and second cross supports;

adjusting the relationship of the cross supports relative to each other;

and fixing the cross supports to the pedicle screws and to the longitudinal support.

17. - The method of claim 16 and comprising:

adjusting the relationship of the cross supports by changing the distance between the cross supports.

18. The method of claim 16 and comprising:  
adjusting the relationship of the cross supports by changing the angle of the first cross support relative to the second cross support in a plane.

19. The method of claim 16 and comprising:  
Adjusting the relationship of the first cross support relative to the second cross support by rotating the first cross support relative to the second cross support about a longitudinal axis of said longitudinal support.

20. The method of claim 16 and comprising:  
prior to connecting said cross supports to said pedicle screws, removing of portions of spinal processes adjacent said motion segments to establish a valley at said motion segments; and locating said longitudinal support in said valley.

21. The method of claim 20 and further comprising:  
manipulating the supports in association with the valley at levels of the spinal region associated with said motion segments.

22. The method of claim 21 and further comprising:  
manipulating the supports by moving telescoping portions of the longitudinal support to provide desired compression and distraction at vertebral bodies associated with said motion segments.

23. The method of claim 21 and further comprising:  
manipulating the supports by rotating one of said cross supports relative to the other  
cross support about a longitudinal axis of said longitudinal support.

24. The method of claim 21 and further comprising:  
manipulation of the supports by pivoting one of said cross supports relative to said  
other cross support in a plane containing said other cross support.

25. A method of instrumentation for patients undergoing spinal treatment and  
comprising:

removing some bone from spinous processes of vertebral bodies adjacent selected  
motion segments of the spine to provide cavities at the posterior of the spine;

securing a plurality of pairs of pedicle screws in said vertebral bodies, one screw of  
each pair being in a first column at one side of the spinal foramen, the other screw of each  
pair being in a second column at the other side of the spinal foramen;

using a plurality of cross supports, each of which cross supports has first and second  
opposite ends, and connecting said cross supports to said pairs by connecting the first end of  
each cross support to one screw of one of said pairs, and connecting the second end of said  
cross support to the other screw of said one pair;

placing in said cavities, a longitudinal support connected to said cross supports;

manipulating said supports to positions to correct relationship of some of said  
vertebral bodies relative to others of said vertebral bodies; and  
locking said supports in said positions.

26. The method of claim 25 and further comprising:

installing said pedicle screws with trajectory from posterior lateral to anterior medial.

27. The method of claim 26 and further comprising:

projecting ends of said transverse supports from posterior forward around facets to connect to said pedicle screws.

28. The method of claim 25 and further comprising:

installing said pedicle screws with trajectory from posterior medial to anterior lateral.

29. The method of claim 28 and further comprising:

installing said pedicle screws entering the cephalid border of the pars interarticularis at the junction of the caudal aspect of the interior facet, at opposite sides of the spine.

30. The method of claim 25 and wherein:

manipulating said supports includes deforming said longitudinal support.

31. The method of claim 25 and wherein:

manipulating said supports includes swiveling at least one of said cross supports relative to said longitudinal support.

32. The method of claim 31 and wherein:

manipulating said supports includes swiveling more than one of said cross supports relative to said longitudinal support.

33. The method of claim 25 and wherein:

manipulating said supports includes changing the length of said longitudinal support.

34. The method of claim 25 and wherein:

manipulating said supports includes rotating a portion of said longitudinal support

relative to another portion of said longitudinal support.

35. A spinal fixation system comprising:

a plurality of pedicle screws spaced along two paths for anchoring in spinal bone in a first column on one side of the spine and in a second column on the other side of the spine, said screws having heads;

a longitudinal support for extending along the spine in space vacated by removal of spinous process portions;

a plurality of cross supports longitudinally spaced on and connected to said longitudinal support and connected to the said screws;

swivel joints at spaced locations on said longitudinal support and connecting selected ones of said cross supports to said longitudinal support; and

means for locking said swivel joints to fix said cross supports in various orientations relative to said longitudinal support.

36. The system of claim 35 and wherein:

said cross supports have ends; and

one end of each cross support is fastened to the head of a screw in the first column and the other end of each cross support is fastened to the head of a screw in the second column.

37. The system of claim 36 and wherein:

said cross supports have posterior and anterior surfaces; and portions of said cross supports near said ends are formed to project in directions from posterior to anterior, to extend around spinal facets.

38. The system of claim 36 and further comprising:

sliding joints at selected locations on said longitudinal support and enabling change of spacing between certain ones of said cross supports; and means on said longitudinal support for locking said sliding joints to fix spacing between said certain ones of said cross supports.

39. The system of claim 38 and wherein:

said longitudinal support at said sliding joints comprises telescoping tubing portions.

40. The system of claim 39 and wherein:

said cross supports are elongate.